FOREWORD

All our knowledge has its origins in our perceptions. - Leonardo Da Vinci

As a U.S. Army attack helicopter pilot and veteran user of night vision goggles (NVG) and forward-looking infrared (FLIR) pilotage systems since 1989, I have an ingrained appreciation for the technology pilots use to enhance situation awareness (SA) on the battlefield and in training. SA is defined as knowing where you are in 3-dimensional space, in particular knowing where you are with respect to other military assets (e.g., planes, tanks, troops) and the surrounding terrain/man-made objects. One of the most anxiety-ridden moments faced by any military pilot is a loss of SA while navigating from one place to another. Coupled with a low fuel situation, I can see where a sense of urgency in recognizing familiar terrain features could be heightened. This situation becomes even more stressful when you, the pilot, compound your misplaced aircraft problem with doing so at night. Here is when you need your night vision system to translate the most recognizable rendition of the actual outside world to your brain. At these moments you either thank, or curse, the technology gods for your respective night vision imaging systems and their displays.

The current helmet-mounted display (HMD) systems have a rich history steeped in military needs met by engineering advancements in optics coupled with enhanced understanding of the human night vision dilemma. NVG technology came online in the early 1970's as the U.S. Army was attempting to expand its night warfighting capability. Ground assets were already using goggles mounted to their headgear when Army aviation began using a 2nd generation version. NVGs provide the viewer with an "enhanced" scene of an otherwise darkened landscape through light amplification. The scene is presented in green or orange based upon the phosphor color used in the goggles. The major problem with the older NVG systems was poor visual acuity and depth perception. Where the system lacked in providing visual cues, the pilot made up for through diligence in general piloting skills (e.g., altitude awareness, constant scanning). By the mid- to late-1970s, thermal (infrared) technology (e.g., FLIR) became available as a sensor technology integrated *into the airframe* in the form of the AH-64 Apache Advanced Attack Helicopter. FLIR used variances in temperature to present an object otherwise obscured in darkness. Objects (e.g., a tank, truck, water tower) may not have looked anything like their daytime images, but they were discernable all the same. The image was presented to the pilot through a single helmet-mounted eyepiece that incorporated the use of a cathode-ray-tube (similar to those used in the old TV sets). Both the NVG and FLIR systems in use today have undergone multiple advancements allowing for improved visual acuity and diminished pilot workload. Until recently applications were limited to these two systems, but as new technological advances are realized, new systems are emerging.

This book will provide insight for pilots, educators, academics, and the general public who are interested in the field of human factors engineering, military night flight operations, and the visual and auditory science behind the improvements in advanced aviation (and other Warfighter) sensor systems. From the explanation of the human-machine interaction dilemma, through the detailing of visual and auditory display systems, this book provides the reader a thorough understanding of the issues related to military operations with respect to our senses, how we perceive what is represented, and ultimately how we assimilate and react to this information.

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